

2004 Satellite Direct Readout Conference

A Decade in Transition

Miami, Florida
December 6-10, 2004

The Role of Satellite Data in the Canadian Meteorological Center

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12/28/2004



Environnement Canada
Centre météorologique canadien

Environment Canada
Canadian Meteorological Centre

Introduction

- What is MSC.
- MSC's Satellite Receiving Network.
- What is CMC
- Current satellite data assimilated at CMC.
- Some results.
- The future.



MSC

MSC - Meteorological Service of Canada

Regional offices -

- Responsible for local forecasts

- Provide products to local clients.

CMC – Canadian Meteorological Center

- MSC's national numerical weather prediction center.

GOES-East Receive Sites



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GOES-East & West Receive Sites



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HRPT Receive Sites

▲ Direct Receive



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HRPT Receive Sites



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CMC



Our models run on a IBM supercomputer

Currently consists of 26 cabinets of IBM P-Series 690

A total of 832 CPU's, in theory 4.3 Tflops

CMC Operational Models

- GEM model (global, regional)
- 3D-Var assimilation on model η levels (T108)
- Background errors from 24-48 method
- Observations QC with BG check and QC-VAR

Global Model

- Uniform grid
- Resolution of $.9^\circ$ (~100 km)
- 28 eta levels
- Kuo convection scheme
- Sundqvist stratiform scheme
- Force-restore surface module with climatological soil moisture
- 10 day forecasts at 00Z and 6 day forecasts at 12Z.
- Cut-off of T+3h00

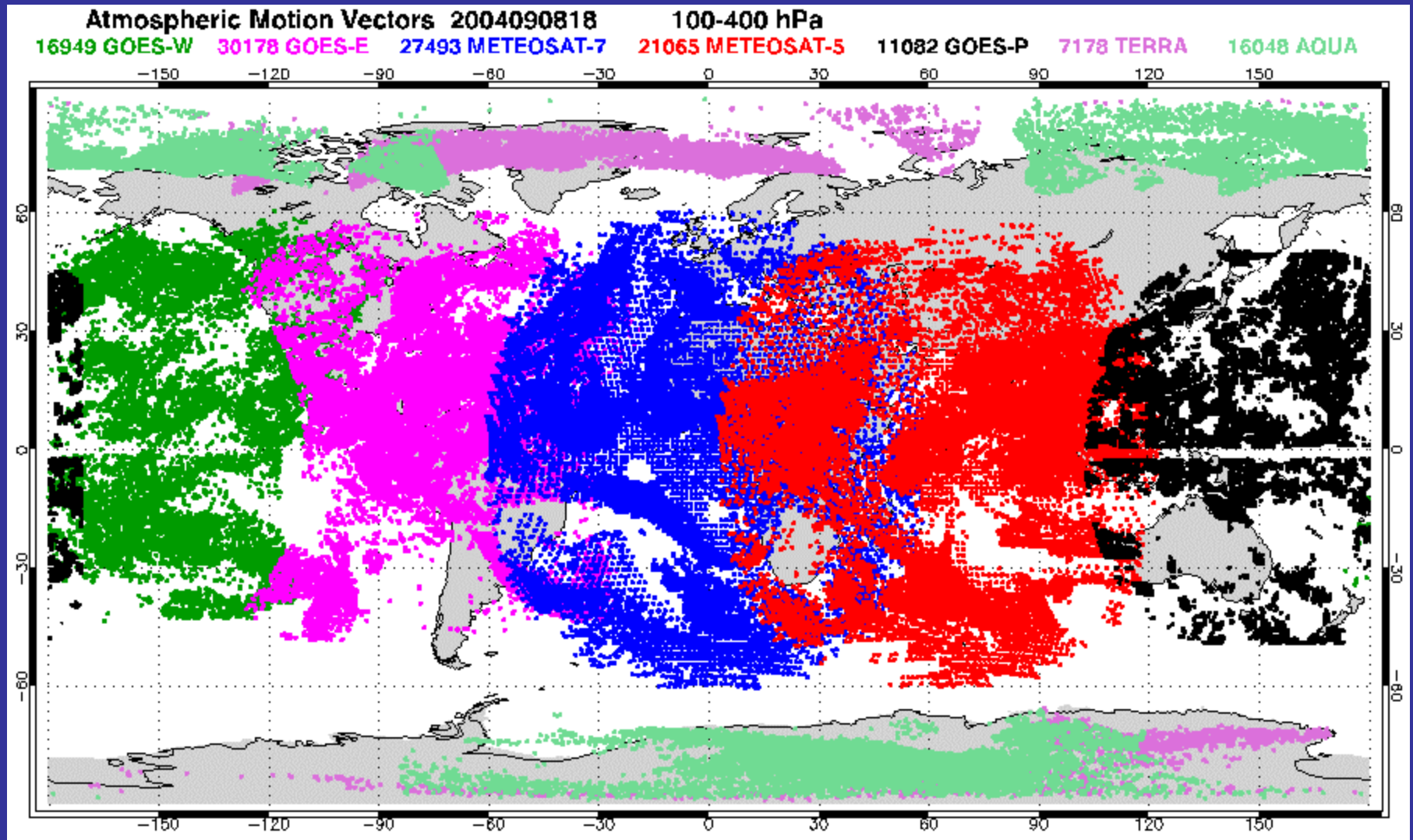
Regional Model

- **Variable resolution grid**
- **Resolution of $.1375^\circ$ (~15 km)**
- **58 eta levels**
- **Kain-Fritsch scheme**
- **Sundqvist stratiform scheme**
- **ISBA surface module with soil moisture pseudo-analysis (error feedback, no data)**
- **48-hour forecasts (00Z -12Z)**
- **Cut-off of T+1h40**

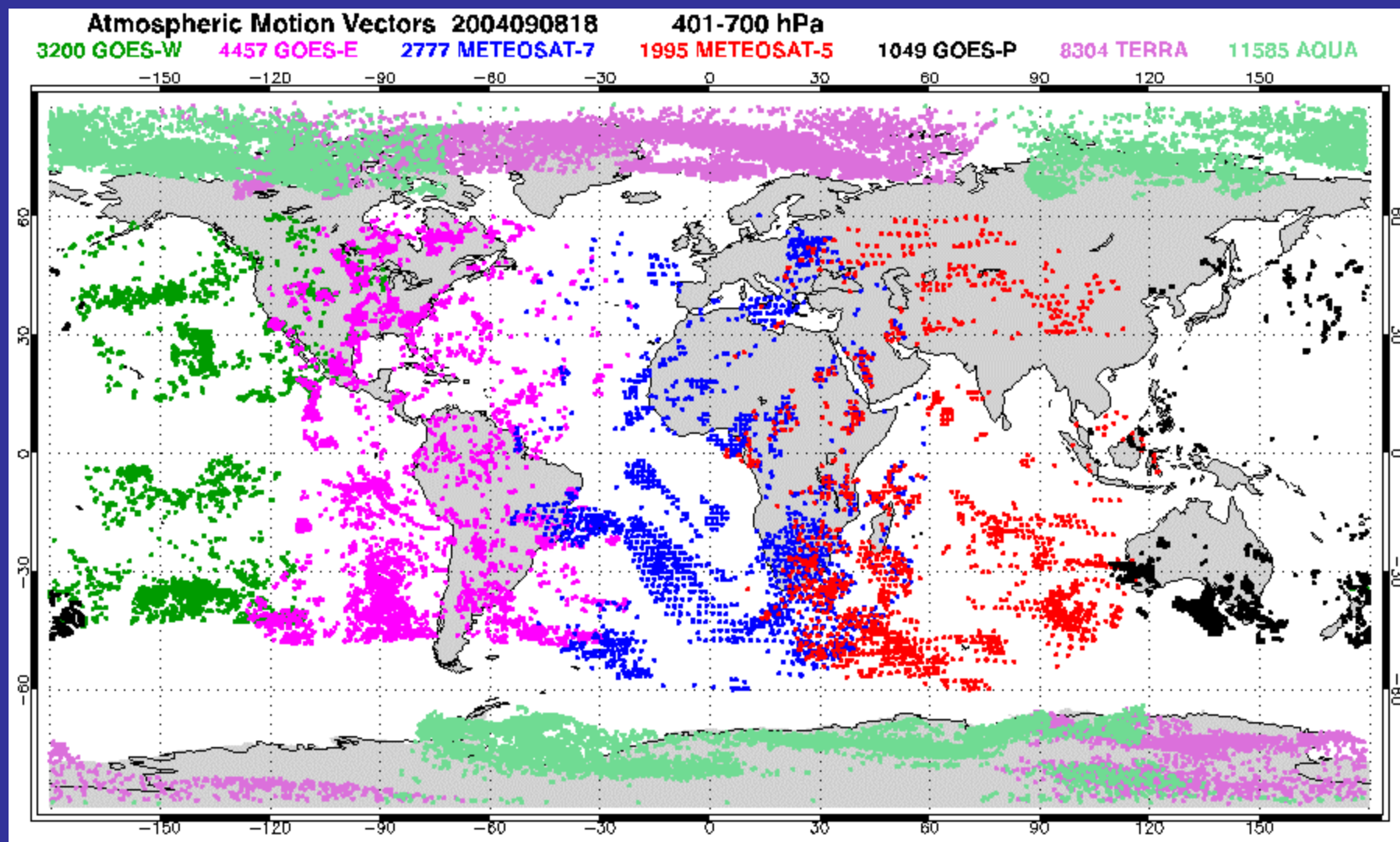
Satellite Data Assimilated at CMC

FORMAT / INSTRUMENT	PLATFORM	VARIABLES
• NOAA ATOVS amsu-a & amsu-b	NOAA series (amsu-a, amsu-b) Aqua (amsu-a)	• radiance
• GOES imager	GOES-W GOES-E	• radiance
• AMVs (IR, WV, VI channels)	GOES-E/W/P, METEOSAT-5/7 Terra & Aqua (Modis)	• derived winds

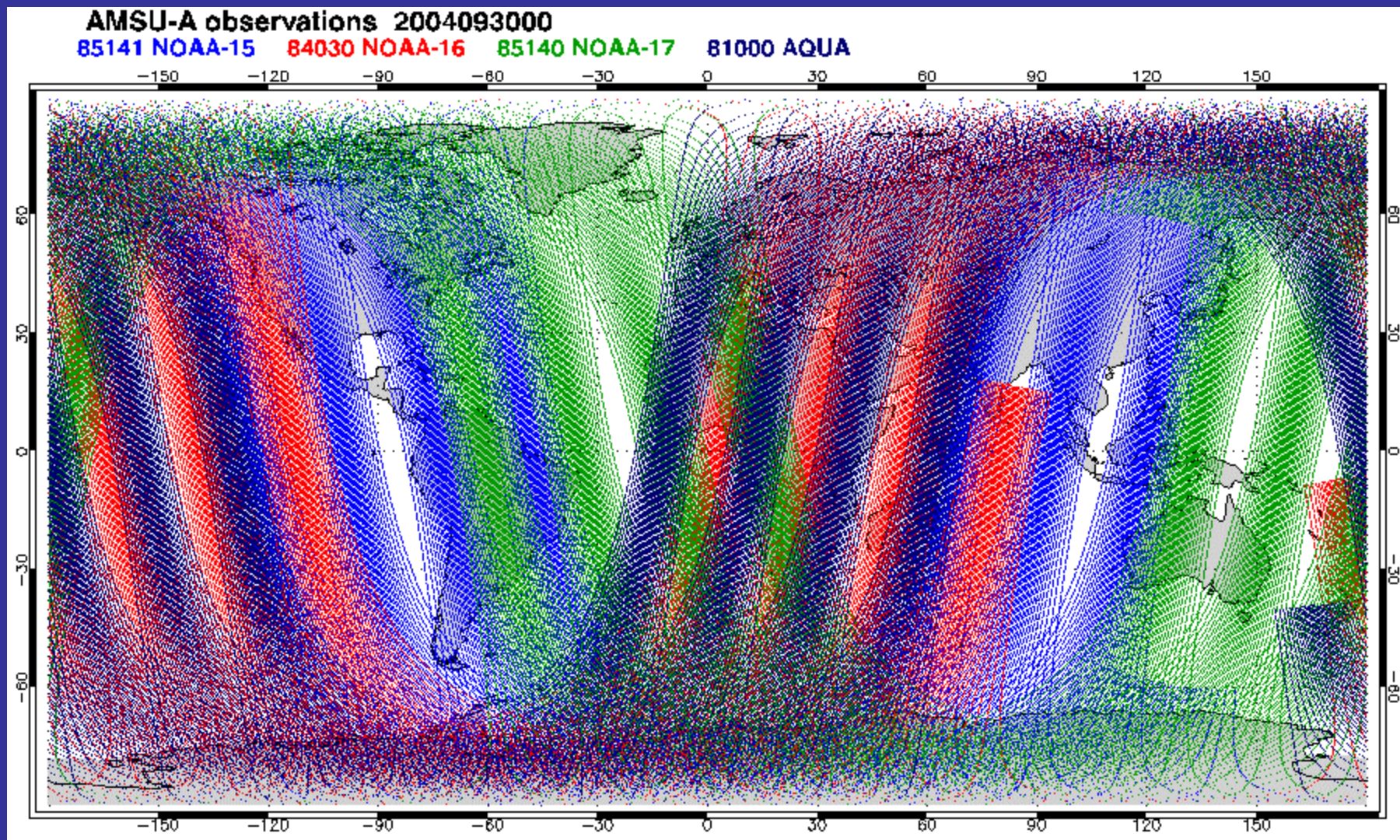
Example coverage of Atmospheric Motion Winds 100-400 hPa (6 hour period)



Example coverage of Atmospheric motion winds 401-700 hPa (6 hour period)



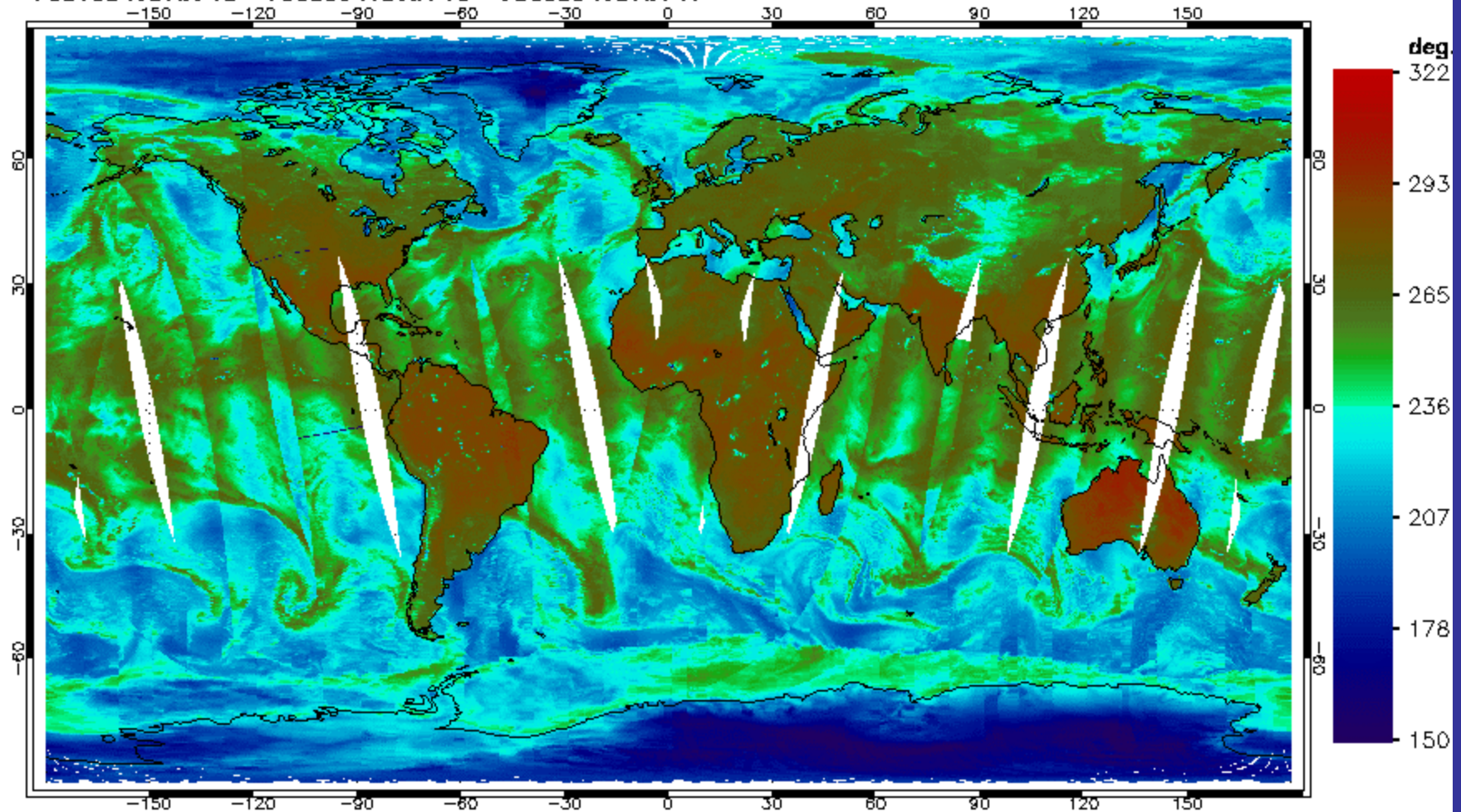
Example coverage of AMSUA data (6 hour period)



Example coverage of AMSUB data (6 hour period)

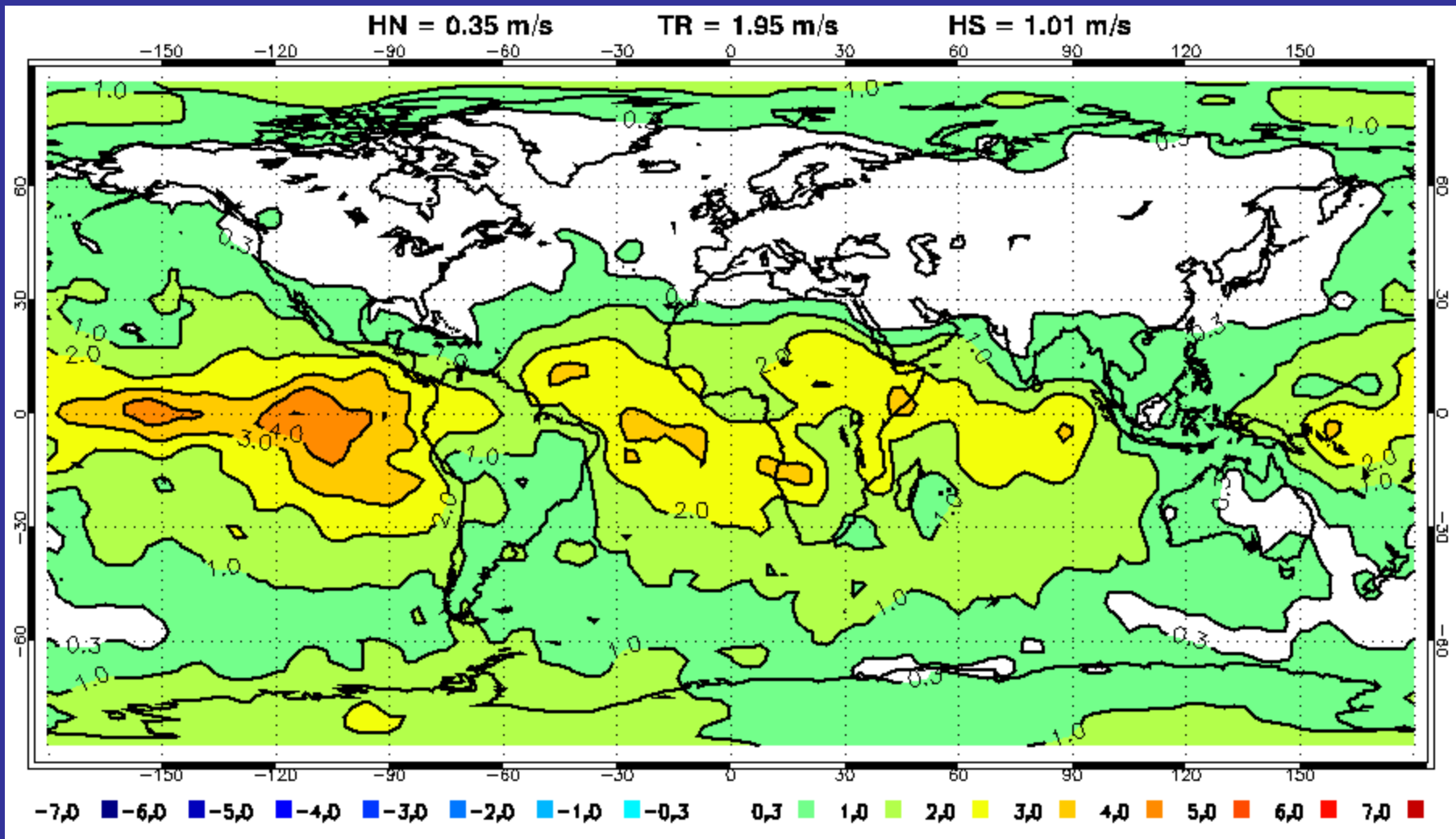
2004093000 NOAA-15/16/17 AMSU-B channel 1 Brightness Temperature

766168 NOAA-15 756359 NOAA-16 756359 NOAA-17



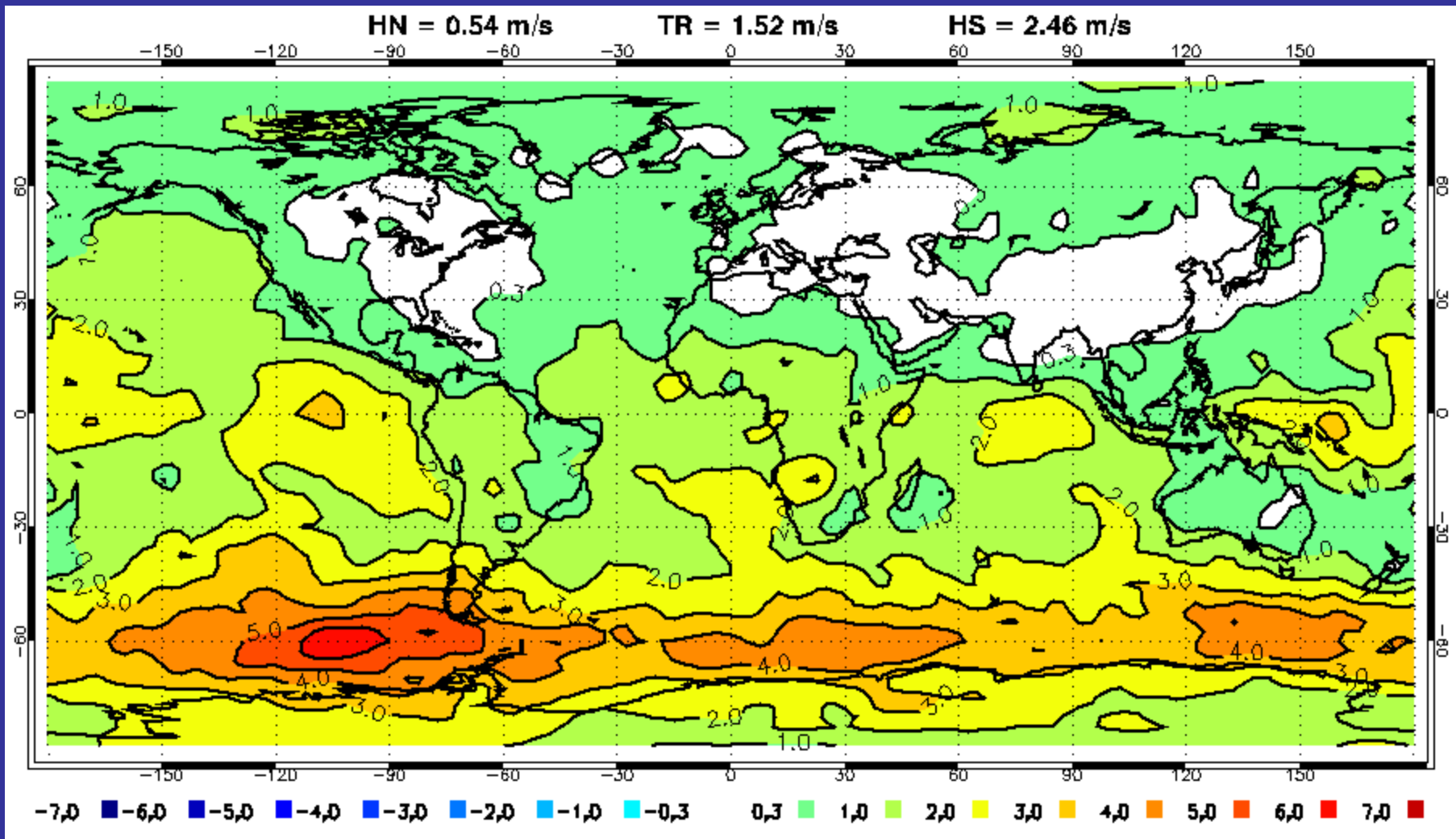
Impact of all Atmospheric Motion Vectors

Difference in RMS of 24-hours Forecast errors,
verified against Control analyses done with all the observations:
No AMVs – Control, 500 hPa wind vector (m/s), 2003110800-2004012512



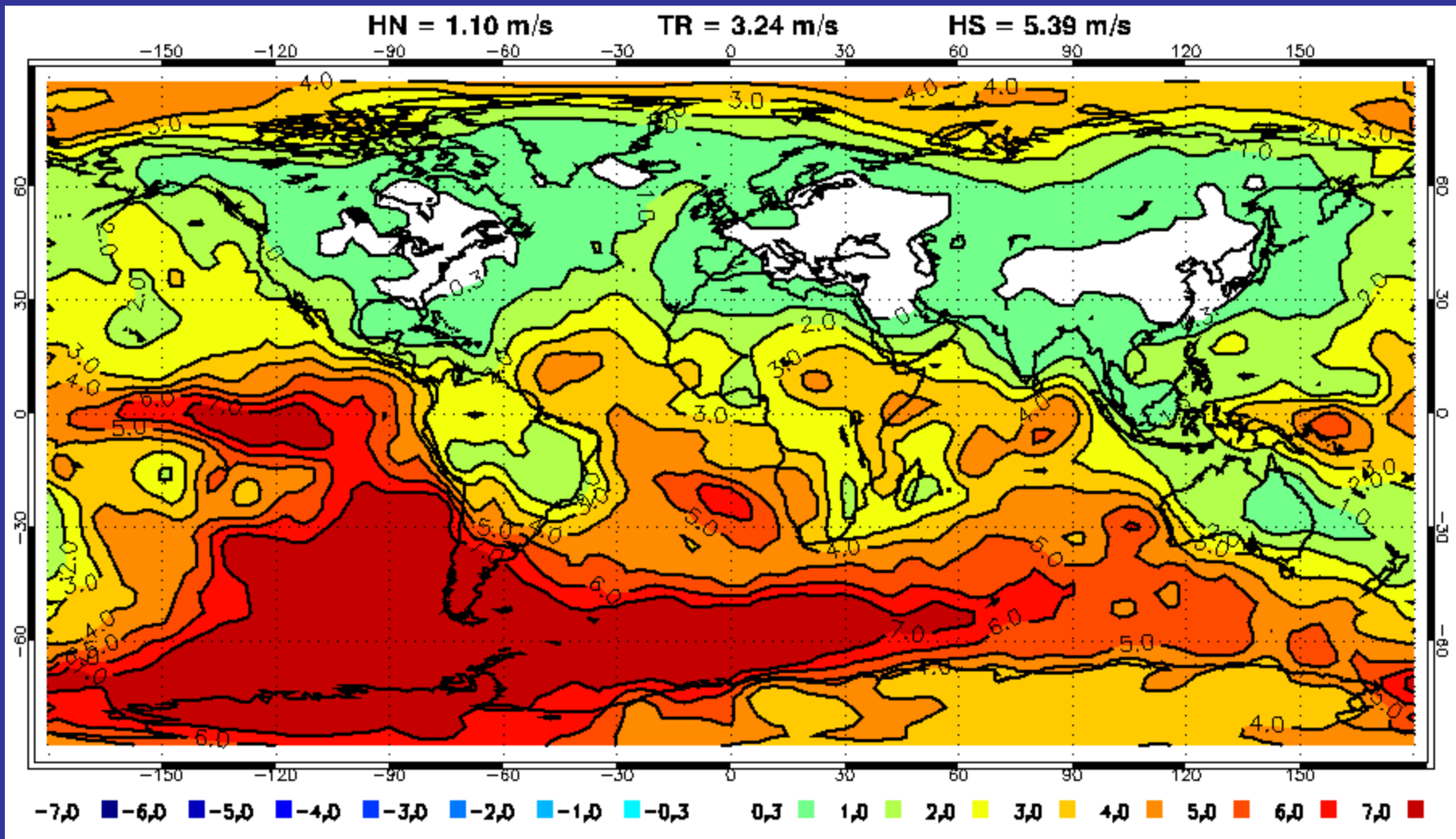
Impact of Satellite radiance

Difference in RMS of 24-hours Forecast errors,
verified against Control analyses done with all the observations:
No Rad – Control, 500 hPa wind vector (m/s), 2003110800-2004012512



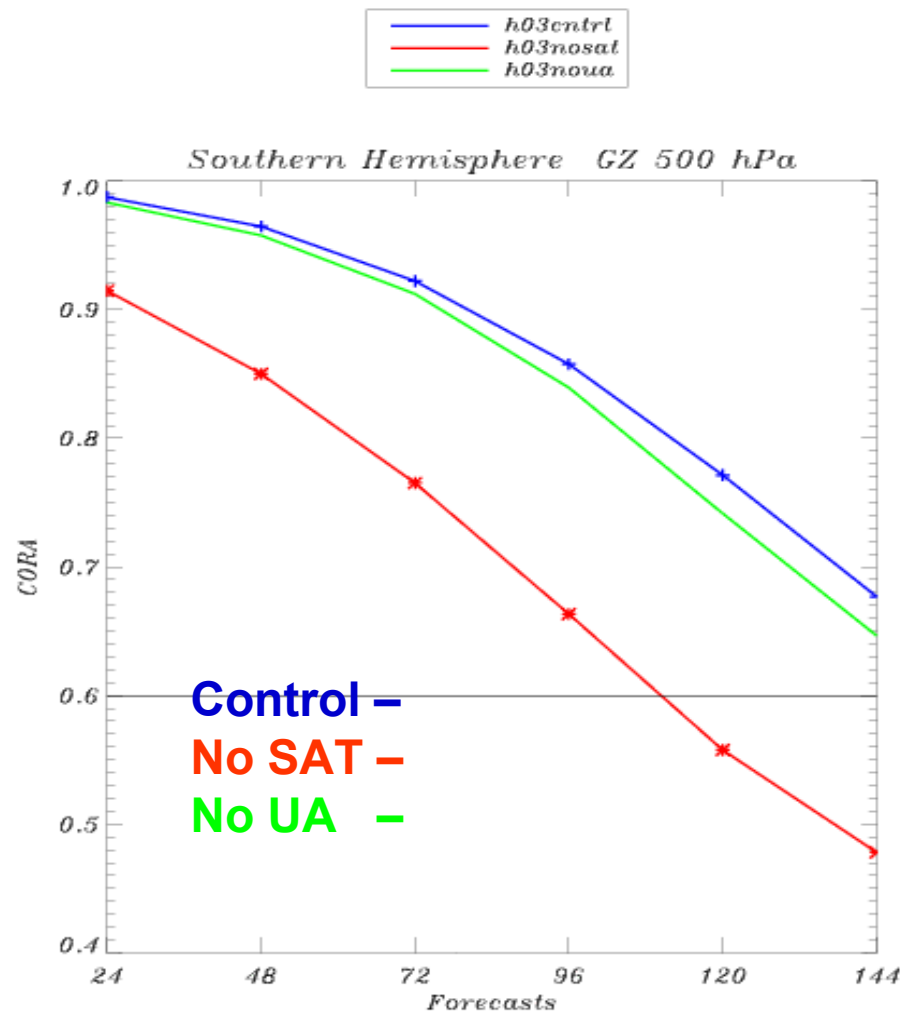
Impact of all Satellite observations

Difference in RMS of 24-hours Forecast errors,
verified against Control analyses done with all the observations:
No Sat – Control, 500 hPa wind vector (m/s), 2003110800-2004012512

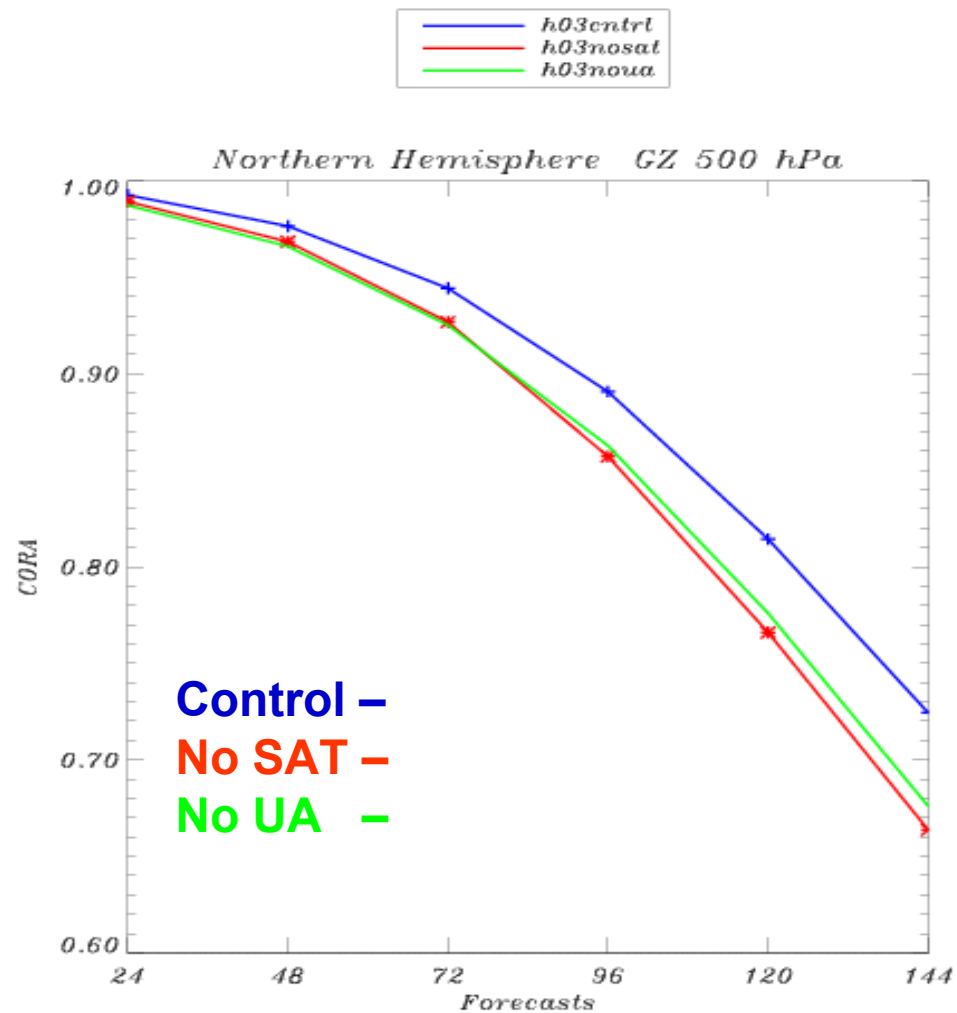


Impact of satellite data in CMC assimilation system

Anomaly correlation of GZ 500 hPa forecasts of day 1-6
launched of every 12 hours from Dec 03 - Jan 04



Southern Hemisphere



Northern Hemisphere

The Next Few Years

In the CMC system the impact of satellite data is about to exceed that of the radiosondes over North America,

Satellite instruments currently assimilated:

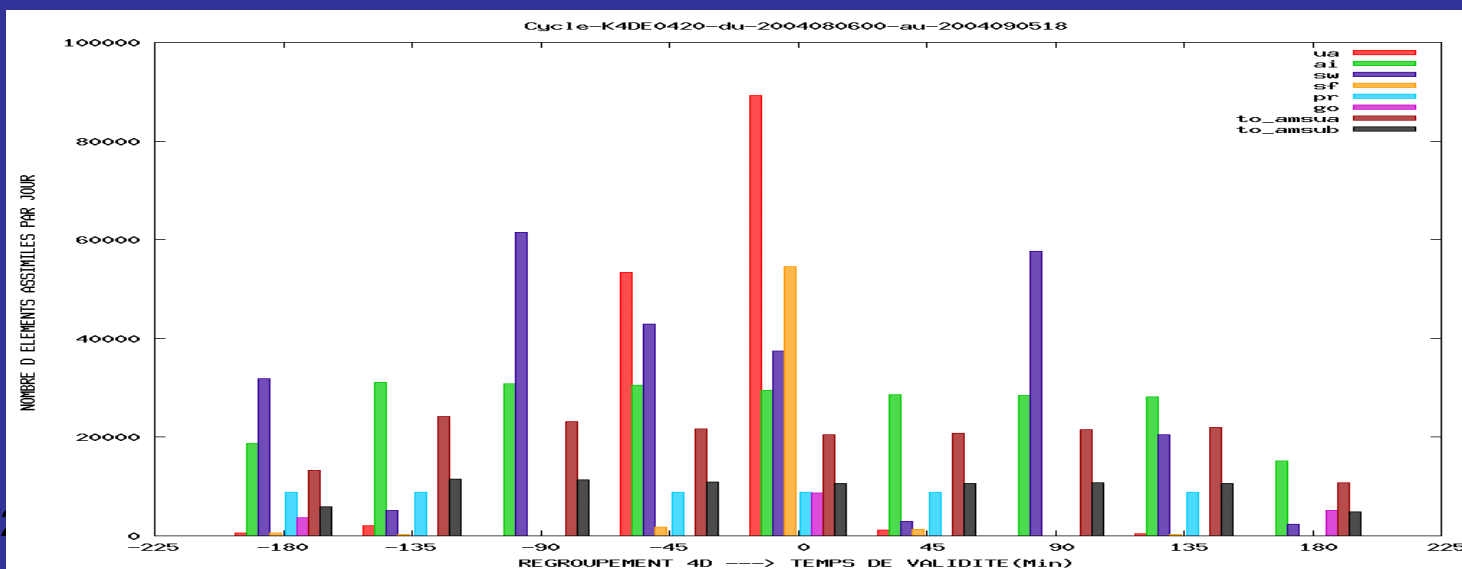
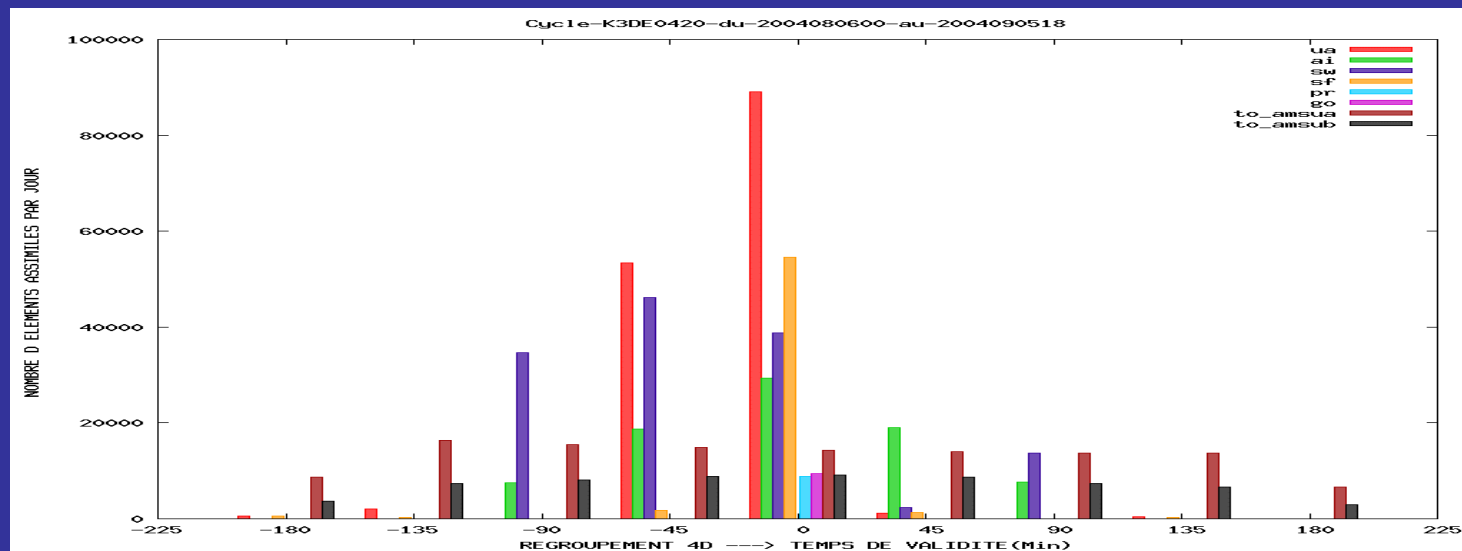
- Microwave instruments (AMSU-A and AMSU-B)
- Imager infrared radiance data (GOES)
- SATWIND and MODIS wind data

Satellite instruments to be assimilated in the near future:

- SSM/I, METEOSAT, QuickScat surface winds
- Hyperspectral infrared sounders
 - AIRS, CMC plans to process ~100 channels by end of 2005
 - IASI (launch 2005) with 8000 channels ?
- GPS radio-occultation
- Doppler wind lidar (ADM-AEOLUS, 2007)

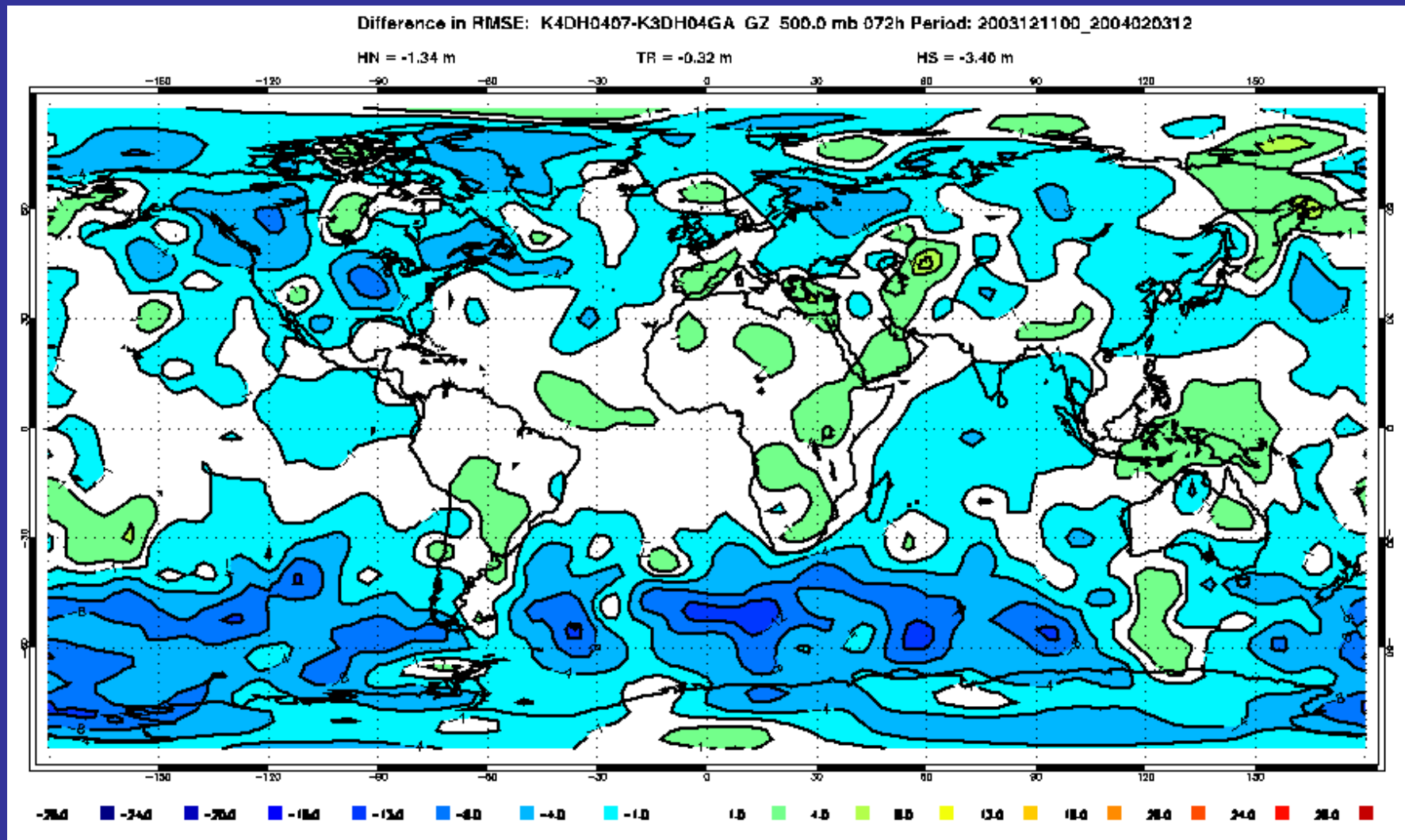
4D-Var Data assimilation system in early 2005

Data Quantities for 3D-Var Versus 4D-Var



Winter cycle 2003-2004

Verification Difference (4D-Var – 3D-Var) GZ 500 hPa at 72h



The Future ~2012

In the planning stage at CMC for the 2012 era –

Regional models running at 1km resolution

“Urban models” with resolutions of ~250m

Time steps of 15 minutes or less

Geostationary-

Full disk (60N – 60S) every 30 minutes for NWP

Full disk (60N – 60S) every 15 minutes for forecast ops.

Microwave Sounder (highly desirable)

Polar Orbiters-

Sounder resolution of 8 km

Imager resolution for surface channels ~250 m

Imager resolution for other channels ~500 m

The Future ~2012 (cont)

Problem: unable to assimilate radiances for cloudy pixels.

Data should come with information on cloud amount in each pixel.
Implies collocation with high resolution Vis/IR sensor with the same footprint as can be done with AIRS and MODIS.

Computationally intensive, should it be done at central location, NESDIS perhaps?

With 4D-Var assimilation, timeliness of data becomes more critical.

Data needs to arrive within 30 minutes of ingest.

Large volumes of data and short delivery times...

The solution is ?

Links of Interest

CMC's Public Site:

<http://www.msc-smc.ec.gc.ca/cmc/>

MSC's Public Site:

<http://www.msc-smc.ec.gc.ca/>

MSC Public Forecast Site:

<http://www.weatheroffice.ec.gc.ca/>

That's All

Thank you.

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